

this he deduces the law of Dalton and Gay Lussac, and he further establishes, though in an incomplete manner, the law that in mixed gases the mean kinetic energy is the same for the different sets of molecules present, from which Avogadro's law and Graham's law of diffusion follow at once. The memoir also contains the first calculation of molecular velocity, and points out the relation of this velocity to the velocity of sound.

The papers on the relative densities of hydrogen and oxygen find a fitting sequel in some of the earlier papers of the fourth volume, the first of which is on the density of nitrogen, Article 197. This begins:—

"I am much puzzled by some recent results as to the density of nitrogen, and shall be obliged if any of your chemical readers"—the article is a letter to this *Journal*, *NATURE*, vol. xlv. pp. 512, 513, 1892—"can offer suggestions as to the cause. According to two methods of preparation I obtain quite distinct values. The relative difference, amounting to about 1/1000 part¹ is small in itself, but it lies entirely outside the errors of experiment, and can only be attributed to a variation in the character of the gas."

And the paper concludes:—

"Is it possible that the difference is independent of impurity, the nitrogen being to some extent in a different (dissociated) state?"

The matter is again referred to in the Royal Society paper, No. 201, on the density of the principal gases, published in the *Proceedings* of 1893, and in detail in Article 210. On an anomaly encountered in determinations of the density of nitrogen gas (*Proc. Roy. Soc.*, 1894), when it appeared that while the weight of nitrogen derived from the air required to fill a certain globe under standard conditions was 2.3102 grammes, when the nitrogen was obtained as a chemical product from other sources than the air the weight was 2.2990 grammes, a difference of 11 milligrammes, or one-half per cent. The question was answered satisfactorily by the paper which appears as No. 214, "Argon, a New Constituent of the Atmosphere," by Lord Rayleigh, Sec.R.S., and Prof. William Ramsay, F.R.S. (*Phil. Trans.*, clxxxvi., A, 1895), and an interesting account of the discovery is contained in the Royal Institution lecture on argon, which forms Article 215.

The *Phil. Trans.* paper contains the account of the means used to separate from the nitrogen of the air the new dense gas the presence of which Lord Rayleigh had discovered, as a residual, by the accuracy of his weighings.

A number of further papers dealing with argon and some of the other new gases are contained in this volume. One of the latest is on the verification of Boyle's law for low pressures. There is also much valuable optical work, specially, perhaps, Article 198, on the intensity of light reflected from water and mercury at nearly perpendicular incidence, and many important investigations of a mathematical character on the electromagnetic theory of light. Among these may be noted Article 227, on the passage of waves through apertures in plane screens, and Article 230, on the incidence of aerial and electric waves on small obstacles.

Perhaps enough has been written to convey to readers who are not professed students of physics the width of range and the power of Lord Rayleigh's work, and to unite them with those who look to him as their leader and master in thanking him for collecting his papers in these four volumes, and rendering them accessible to all.

It is almost needless to add that the University Press has done its part admirably, and fully deserves the thanks of students of nature for its share in the work.

Within a few years the Cambridge Press has published the collected works of Adams, Cayley, Maxwell, Stokes, Tait, Kelvin, Reynolds, and Rayleigh, men whose names will ever make the Cambridge school of mathematics and physics of the last half of the nineteenth century famous in the history of science.

MICRO-ORGANISMS IN THE ARTS AND MANUFACTURES.

Technical Mycology: the Utilisation of Micro-organisms in the Arts and Manufactures. By Dr. Lafar. Translated by C. T. C. Salter. Vol. ii. *Eumycetic Fermentation*, Part i. Pp. viii+189. (London: C. Griffin and Co., Ltd., 1903.)

THE first volume of Mr. Salter's translation of Dr. Lafar's "Technical Mycology," which made its appearance some four or five years ago, opened up to the general reader a very wide and interesting field, the utilisation of micro-organisms in the arts and manufactures. This volume dealt with schizomycetic fermentation, and to the uninitiated who had not looked into the scheme of the whole work, it appeared as though almost the last word must have been said on fungi and fermentation.

The first part of the second volume, the advent of which has been eagerly awaited, has now come to hand, and we may say at once that in many ways it is equal to the first volume and that, not only have we the results of the author's own experience and observations, but a *résumé* of the results of others well brought up to date. This volume deals with the eumycetic fermentation and opens with a series of chapters on the rudiments of the general morphology and physiology of the Eumycetes, chapters of as great interest to the general biologist as to the bacteriologist and fungologist. A short description of the structure of the Eumycetes is given, the method of spore formation, the development of the mycelium from the spore, the gemmating mycelium, and the various methods of reproduction—fructification by sporangia, zygosporangia, conidia, or by the formation of oidia and gemmæ without the intervention of conidiophores. The author refers the reader for more detailed accounts of structure and function to the early text-books provided by Zopf, De Bary, and Brefeld, but supplements these works by carefully written chapters on certain parts of the subject on which much work has been done since the appearance of these text-books. He describes the researches which have been carried out on the celluloses, chitin, hemicelluloses, and other carbohydrates of which these fungi are composed, dis-

¹ The difference ultimately found was 1/200.

cusses the position of their colouring matter and ascribes the waterproof character of certain cell membranes to the deposition of excreted fatty or waxy substances, pointing out that this waterproof character is of importance biologically,

"since it prevents the penetration of toxic substances from the surrounding aqueous medium, and thereby also opposes the attempts of the mycologist to kill such fungi by means of aqueous toxic solutions."

A chapter is devoted to the mineral nutrient matter utilised by the Eumycetes, the author indicating that certain substances which are not absolutely necessary for the nutrition of these organisms may still, as in the case of nickel, cobalt, and manganese, like iron, exert a stimulative action on the growth of fungi. Sulphur, selenium, and silicon may also be found in the protoplasm of these fungi, but phosphorus appears to be a most important element in their composition, and, although arsenic does not take the place of the phosphorus in the Eumycetes, certain of these organisms appear to have the power of converting arsenious acid into volatile compounds having an odour of garlic. These organisms have, therefore, been used for the purpose of indicating the presence of arsenic in cases where, by the ordinary Marsh's tests, only a doubtful reaction has been obtained. The influence of light on the development of the Eumycetes is discussed, and it appears that although strong light interferes with their development, moderate illumination interferes very little with their activity. Chemotropism is discussed somewhat fragmentarily; this remark applies also to the diastatic enzymes and the enzymes capable of decomposing fat; the enzymes of yeast, however, are described more fully in the later part of the work.

The special part of the book consists of two sections, one devoted to the fermentation set up by Zygomycetes, the other to a preliminary consideration of yeast-fermentation. The first of these sections is interesting to the technologist from the fact that it deals with Calmette's *Amylomyces Rouxii* or *Mucor Rouxii*, derived from the Chinese yeast-balls used in the preparation of rice spirit. This produces a powerful diastatic enzyme which first produces glucose, and this, in the absence of oxygen, is converted by yeast ferment into alcohol. For a full account of the *Amylomyces* process the reader may be referred to the description of the use of the *Mucoræ* in the spirit industry.

The latter half of part i. of vol. ii. is devoted entirely to yeasts, especially the forms, structure, and chemical composition of the yeast-cell, and anyone who studies this will be amply repaid by obtaining a knowledge of the principles and mechanism of fermentation such as can be obtained elsewhere only by the study of bulky treatises, though now and again one is a little disappointed that the author has not elaborated his descriptions somewhat more fully, this remark applying specially to the chapter on the chemistry of the yeast-cell. The sketch given is so interesting that one would have welcomed a somewhat more detailed account of this part of the work.

After reading this work one feels the truth of Hansen's statement that none of the text-books and

manuals giving a summary of larger or smaller sections of technical microbiology has treated the subject of this extensive field from so comprehensive a point of view as that of Dr. Lafar. In preparing the work, the author has exhibited not only many sided discernment and enthusiasm for his task, but also great courage and endurance. Certainly, this part of the second volume

"will be welcomed not only by those for whom it is primarily intended, viz., technical chemists, chemists dealing with food stuffs, fermentation and agriculture, pharmacists, and agriculturists, but many another worker will derive benefit from its pages for his lectures and researches."

We can cordially recommend this section of Dr. Lafar's work as an excellent supplement to the first volume, which has already been reviewed in our columns.

We are glad to learn that the translators have made arrangements with the German publishers to obtain advance proofs of the German work in order that the concluding sections may appear as soon as possible. This portion of the work fully maintains the interest aroused by the first volume, and the translators are to be congratulated on the fact that they have been able to give so accurately not only the substance, but the spirit of the German work.

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VISUAL PURPLE.

Abhandlungen zur Physiologie der Gesichtsempfindungen. By J. von Kries. Heft. i., 1897, pp. vi+198; Heft. ii., 1902, pp. 197. (Leipzig: Johann Ambrosius Barth.)

THIS is a collection of papers reprinted from the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*. The papers are the work of von Kries and his school, and deal chiefly with visual purple and its functions. They give an account of one of the most important of recent advances in our knowledge of the physiology of sensation.

The discovery of visual purple in 1876 aroused great hopes, which seemed to be frustrated when it was found that the substance was absent from the *fovea*, the place of most distinct vision, and physiologists soon settled down to the view that a substance absent from this situation could have little to do with the production of visual sensations.

In the early days, however, Kühne suggested that the great instability of visual purple made it probable that it was a substance for the perception of feeble light, and Parinaud in France later advanced the same idea. It has been reserved for von Kries to develop fully Kühne's idea.

According to von Kries, visual purple is a substance which supplies the retinal basis for vision at low luminosities, and the accumulation of this substance is accountable for the great increase in sensitiveness of the dark-adapted eye—a thousand-fold increase according to some computations.

The change in the relative brightness of different colours with varying illumination, first pointed out by Purkinje, finds a ready explanation on this view.